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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : D21D 5/02 — A1

(11) International Publication Number: WO 95/11336

(43) International Publication Date: 27 April 1995 (27.04.95)

(21) International Application Number: PCT/CA94/00579

(22) International Filing Date: 18 October 1994 (18.10.94)

(30) Priority Data:
2,108,598 18 October 1993 (18.10.93) CA

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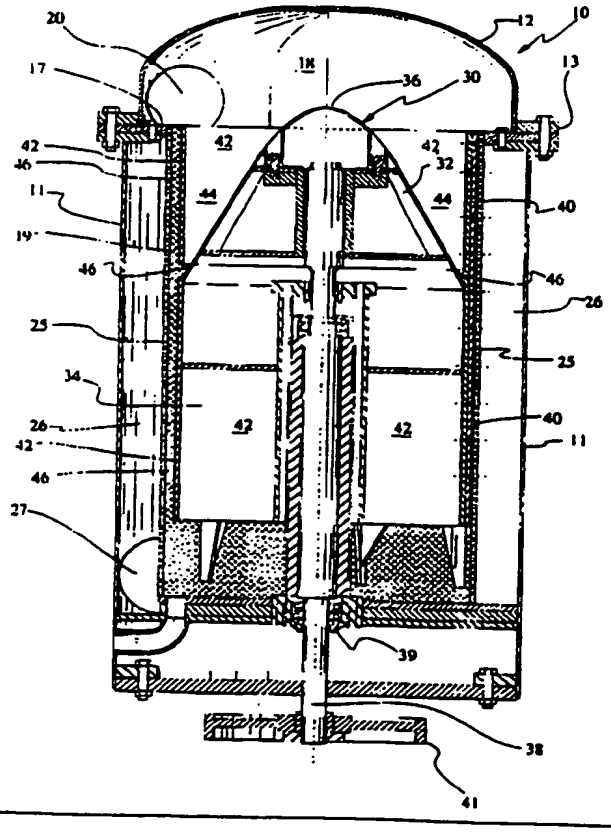
(81) Designated States: AM, AT, AU, BB, BG, BR, BY, CH, CN, CZ, DE, DK, ES, FI, GB, GE, HU, JP, KE, KG, KP, KR, KZ, LK, LT, LU, LV, MD, MG, MN, MW, NL, NO, NZ, PL, PT, RO, RU, SD, SE, SI, SK, TJ, TT, UA, US, UZ, VN, European patent (AT, BE, CH, DE, DK, ES, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG), ARIPO patent (KE, MW, SD, SZ).

Published
With international search report.
With amended claims.

(54) Title: ROTARY SCREENING DEVICE

(57) Abstract

A rotary pulp screening device having a high efficiency. The screening device includes a rotor (30) having an upper paraboloidal segment (32) surrounded by a cylindrical baffle (42) to split the incoming flow of pulp stock in two unequal parts. The predominant part flows through a first passage (44) defined between the baffle and the paraboloidal segment of the rotor and is discharged against the screen at an intermediate axial location. The smallest part of the incoming flow passes between the baffle (42) and the screen (25) and merges with the main stream of the flow when reaching the outlet of the first passage.



I.H 40742

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TITLE: ROTARY SCREENING DEVICE

FIELD OF THE INVENTION

The present invention relates to an apparatus for removing impurities in pulp stock, more particularly to a novel rotary screening device that uses power more efficiently.

BACKGROUND OF THE INVENTION

The screening of wood pulp slurry is necessary in the production of paper to remove large fibers, stones and other rejects. Over the years, equipment and processes to screen pulp have improved. Initially, pulp stock was passed through a vibrating screen, an improvement of this method was a cylindrical pulsating method where foils were rotated inside a screen to produce a pulsating effect on a mat of fibers adjacent the screen. The present method, and the one that is used in most modern paper mills, is the rotating method where fibers are screened in a cylindrical screen, generally a vertical screen. A series of blades rotate inside the screen and pulp slurry is fed to the top of the screen. As the slurry passes through the screen, the fibers are formed into a mat between the screen basket and the impeller blades. The mat rotates due to the movement of the impeller blades and at the same

time has an axial movement downwards so that the reject particles in the pulp stock are held in the mat and conveyed to the bottom of the screen where they are removed in a reject chamber.

The United States patents 4,642,189 issued on February 10, 1987 discloses a rotary pressure screen of this type. The screen features an improved rotor construction allowing to increase the efficiency of the machine. More specifically, the upper section of the rotor has a parabolic shape and carries a frusto-conical baffle. The baffle and the upper section of the rotor define therebetween a first pulp stock passageway that has a constant cross-sectional shape from top to bottom. A second passageway is defined between the outer surface of the frusto-conical baffle and the screen basket. Pulp stock to be screened discharged on top of the rotor is split in two parts that flow through respective passageways and are directed at different axial locations of the screen. As a result of this arrangement, the screen surface is utilized more efficiently.

The present invention is an improvement of this prior art rotary screening device. More particularly, the present inventor has made the surprising discovery that by re-configuring the pulp stock flow splitting baffle a significant gain in efficiency can be achieved.

As embodied and broadly described herein, the invention provides a rotary pulp screening device of the vertical pressure type, comprising:

- a housing defining an upper inlet chamber and a lower screening chamber in fluid communication;

- a generally cylindrical screen mounted in said lower screening chamber;

- a rotor mounted for rotation about a generally vertical axis within said screen, said rotor having an upper section that tapers toward a top end of said rotor;

- a plurality of blades mounted to said rotor and radially extending therefrom to within a short distance from said screen, said blades constitute means for creating localized pressure pulsations in the pulp stock that act against said screen in order to dislodge impurities obturating apertures of said screen;

- a pulp flow splitting baffle having a generally circular configuration mounted to said rotor and encircling said upper section, said baffle and said rotor defining therebetween a first pulp flow passage having a gradually decreasing cross-sectional shape in a direction of pulp flow through said passage, said first pulp flow passage having an outlet opening through which pulp flow is discharged against said screen located at a point intermediate said top end and a bottom end of said rotor, said baffle and said screen defining therebetween a second pulp flow passage having a cross-sectional area

substantially smaller than a cross-sectional area at an inlet end of said first passage, whereby pulp stock discharged in said inlet chamber enters said screening chamber and is split in two substantially unequal parts, a largest one of said parts flowing downward through said first passage toward said outlet opening, a smallest one of said parts flowing downward through said second passage along said screen and merging with pulp stock egressing from said outlet opening.

The dramatic gain in efficiency observed with the screening device in accordance with the invention is a result of splitting the incoming flow of pulp stock to be screened in two substantially unequal parts, the large part flowing between the baffle and the upper section of the rotor and being discharged against the screen at an intermediate axial location thereof, while the smaller part flows between the outer surface of the baffle and the screen basket.

In a most preferred embodiment of the invention, the baffle is generally cylindrical maintaining from top to bottom a constant distance with the screen basket. The baffle is secured to the rotor by the intermediary of the blades provided to clear the screen openings. The blades are in the form of elongated vertical bars bolted to the lower cylindrical portion of the rotor. The upper part of

the blades that extend at the level of the upper section of the rotor define a cage in which the baffle is received and supported. Since the blades extend over the outer surface of the baffle, there cleaning action is effective over the entire surface of the screen. This reduces the possibility of screen clogging and further proves the efficiency of the machine.

BRIEF DESCRIPTION OF THE DRAWINGS

- Figure 1 is a schematical vertical cross-sectional view of a screening device of the pressure type in accordance with the invention;

- Figure 2 is a top plan view of the screening device shown in Figure 1; and

- Figure 3 is a graphical representation of test data illustrating the efficiency of the screening device in accordance with the invention comparatively to a prior art machine.

DESCRIPTION OF A PREFERRED EMBODIMENT

One embodiment of a pulp screening device 10 is shown in Figures 1 and 2 having a generally cylindrical housing 11 with a top cover 12 joined to the cylindrical housing

11 at flange 13. In the cylindrical housing 11, spaced down from the top flange 13, is a disc ring 17 which divides the housing into an upper inlet chamber 18 above the disc ring 17, and a lower screening chamber 19 below the disc ring 17. A tubular inlet pipe 20 provides entry to the inlet chamber 18. Thus, pulp stock admitted in the inlet chamber 18 flows over the disc ring 17 and in the screening chamber 19.

A vertical cylindrical screen 25 is mounted axially in the lower chamber 19, and extends for the full height of the chamber 19. An annular accept chamber 26 which receives accepts completely surrounds the cylindrical screen 25. An outlet 27 at the bottom of the accept chamber 26 in the cylindrical housing 11, outside the screen 25, allows the screen accept fibers to leave the screening device 10.

A rotor 30 is positioned axially within the screen 25. In the embodiment shown, the rotor has an upper upwardly tapering portion 32 that is shaped approximately in the form of a paraboloid segment, and a lower cylindrical section 34. The paraboloid segment is formed from a series of truncated cones joined together and has a curved nose cone 36 on the top so the overall shape of the portion 20 is paraboloidal. The rotor 30 is mounted on a rotating axial shaft 38, which rotates in a bearing

assembly . The drive shaft 34 has a V-belt pulley 41 mounted thereon for connection by means of V-belts to an electric drive motor (not shown in the drawings).

Five blades 40 are equi-spaced about the rotor 30. Each blade 40 is a vertically extending bar bolted to the cylindrical section 34 of the rotor in a parallel relationship with the axis of rotation of the rotor 30. The blade 40 extends for the full height of the screen 25. The blades 40 form at the level of the paraboloidal upper segment of the rotor 30 a cage in which is fitted a pulp stock flow splitting baffle 42. The baffle is cylindrical in shape and has upper and lower edges lying in parallel horizontal planes. It is bolted to the blades 40 that support it on the rotor 30. The baffle 42 is positioned near the inlet end of the screening chamber 19 and provides two distinct passageways for the incoming flow of pulp stock. The first passageway 44 is defined between the baffle 42 and the paraboloidal segment of the rotor 30. It will be noted that this passageway has a gradually decreasing cross-sectional shape in the direction of flow of pulp stock therein which has the effect of gradually increasing the velocity of the pulp stock as the latter travels downwardly in the screening chamber 19. The passageway 44 terminates with an annular outlet 46 defined between the lower edge of the baffle 42 and the upper edge of the lower cylindrical segment 34 of the rotor.

A portion of the pulp stock entering the screening chamber 19 also flows through a second passageway 46 defined between the outer surface of the baffle 42 and the screen 25. The passage 46 has a uniform cross-sectional shape along its length as a result of the constant gap between the baffle 42 and the screen 25. It will be noted that the passage 46 is significantly smaller than the passage 44, particularly than the inlet end of the passage 44.

In operation, pulp stock delivered to the inlet chamber 18 passes over the disc ring 17 and flows in the screening chamber 19. The pulp stock is divided in two parts by the baffle 42. The predominant part flows in the passage 44 and it is gradually accelerated as it advances downwards. The pulp stock in the passageway 44 exits through the annular outlet 46 located at an intermediate point between the axial extremities of the screen 25. Only at this point the pulp stock is in contact with the screen and it is subjected to a screening action while traveling downwards along the lower cylindrical portion 34 of the rotor.

The smaller part of the pulp stock delivered through the inlet of the screening chamber 19 flows through the small annular passage 46. Immediately upon entering this passage, the pulp stock is subjected to screening action.

As it moves downwards along the screen 25, the pulp stock gradually thickens because water is removed at a high rate through the screen apertures. When the thickened pulp stock reaches the annular outlet 46, it is then diluted with the incoming main pulp flow stream and the screening action is then continued along the bottom portion of the screen 25.

As it is well known to those skilled in the art, the purpose of the blades 40 is to unplug the screen apertures. The rotation of the blades 40 causes local pressure pulsations in the pulp stock that act against the screen and are capable of dislodging large fibers or other debris obturating the screen apertures. By providing blades that extend vertically over the lower cylindrical section 34 of the rotor and over the entire axial length of the baffle 42, enables to provide a cleaning action over the full surface of the screeb 25. As a result, the screen basket 25 can be maintained cleaner for a more efficient operation.

In a most preferred embodiment, the screen has an inside diameter of 29.375 inches. The cylindrical baffles defines with the screen 25 a gap of 1.125 inches measured at some point between two adjacent blades. The height of the rotor is of 40.250 inches, the axial dimension of the

baffle 42 is of 14 inches, and the axial dimension of the annular outlet 46 is of 2.8125 inches.

Comparative studies conducted with prior art rotary pulp screening devices have demonstrated the superiority in terms of efficiency of the present rotor design. Test runs conducted with a rotary screen constructed in accordance with the teaching of the above-identified U.S. patent 4,642,189 and a system in accordance with the invention, have shown significant gains in efficiency in favour of the invention. The test data is represented graphically in Figure 3. It will be noted that for a given horse power value the screening device in accordance with the invention has a significantly higher pulp stock screening capacity than the prior art design.

It should be noted that the above description is not intended to be limiting as variations are possible without departing from the spirit of the invention. The scope of the invention is defined in the appended claims and their equivalents.

I CLAIM:

1. A rotary pulp screening device of the vertical pressure type, comprising:

- a housing defining an upper inlet chamber and a lower screening chamber in fluid communication;

- a generally cylindrical screen mounted in said lower screening chamber;

- a rotor mounted for rotation about a generally vertical axis within said screen, said rotor having an upper section that tapers toward a top end of said rotor;

- a plurality of blades mounted to said rotor and radially extending therefrom to within a short distance from said screen, said blades constitute means for creating localized pressure pulsations in the pulp stock that act against said screen in order to dislodge impurities obturating apertures of said screen;

- a pulp flow splitting baffle having a generally circular configuration mounted to said rotor and encircling said upper section, said baffle and said rotor defining therebetween a first pulp flow passage having a gradually decreasing cross-sectional shape in a direction of pulp flow through said passage, said first pulp flow passage having an outlet opening through which pulp flow is discharged against said screen located at a point intermediate said top end an a bottom end of said rotor, said baffle and said screen defining therebetween a second pulp flow passage having a cross-sectional area substantially smaller than a cross-sectional area at an

inlet end of said first passage, whereby pulp stock discharged in said inlet chamber enters said screening chamber and is split in two substantially unequal parts, a largest one of said parts flowing downward through said first passage toward said outlet opening, a smallest one of said parts flowing downward through said second passage along said screen and merging with pulp stock egressing from said outlet opening.

2. A rotary pulp screening device as defined in claim 1, wherein said baffle is generally cylindrical.

3. A rotary pulp screening device as defined in claim wherein said impeller blades extend generally vertically over an outer surface of said baffle.

4. A rotary pulp screening device as defined in claim 1, wherein said impeller blades extend generally vertically and are secured to a lower section of said rotor, upper portions of said blades extending at a level of said upper section define a cage receiving and supporting said baffle.

5. A rotary pulp screening device as defined in claim 1, wherein said upper section is generally parabolic.

AMENDED CLAIMS

[received by the International Bureau on 3 March 1995 (03.03.95); original claims cancelled; original claim 1 amended; claims 4 and 5 amended and renumbered as claims 5 and 6; new claim 2 added; claims 2 and 3 renumbered as claims 3 and 4 (2 pages)]

1. A rotary pulp screening device, comprising:

- a housing defining an inlet chamber and a screening chamber in fluid communication, said screening chamber being located downstream of said inlet chamber with relation to a direction of flow of pulp stock through said chambers;

- a generally cylindrical screen mounted in said screening chamber;

- a rotor mounted for rotation about an axis in said screen, said rotor having an inlet section that tapers toward a first end of said rotor;

- a plurality of blades mounted to said rotor and radially extending therefrom to within a short distance from said screen, said blades providing means for creating localized pressure pulsations in the pulp stock that act against said screen in order to dislodge impurities obturating apertures of said screen;

- a pulp flow splitting baffle mounted to said rotor and encircling said inlet section, said baffle and said rotor defining therebetween a first pulp flow passage having a gradually decreasing cross-sectional shape in a direction of pulp flow through said passage, said first pulp flow passage having an outlet opening through which pulp flow is discharged toward said screen located at a point intermediate said first end and a second end of said rotor, said baffle and said screen defining therebetween a second pulp flow passage having a cross-sectional area substantially smaller than a cross-sectional area at an inlet end of said first passage, whereby pulp stock discharged in said inlet chamber is split in two substantially unequal parts, a largest one of said parts flowing through said first passage toward said outlet opening, a smallest one of said parts flowing through said

second passage along said screen and merging with pulp stock egressing from said outlet opening.

2. A rotary pulp screening device as defined in claim 1, wherein said rotor is mounted for rotation about a generally vertical axis within said screen and wherein said inlet chamber is located above said screening chamber.

3. A rotary pulp screening device as defined in claim 2, wherein said baffle is generally cylindrical.

4. A rotary pulp screening device as defined in claim 2, wherein said impeller blades extend generally vertically over an outer surface of said baffle.

5. A rotary pulp screening device as defined in claim 2, wherein said impeller blades extend generally vertically and are secured to a lower section of said rotor, upper portions of said blades extending at a level of said inlet section to define a cage receiving and supporting said baffle.

6. A rotary pulp screening device as defined in claim 2, wherein said inlet section is generally parabolic.

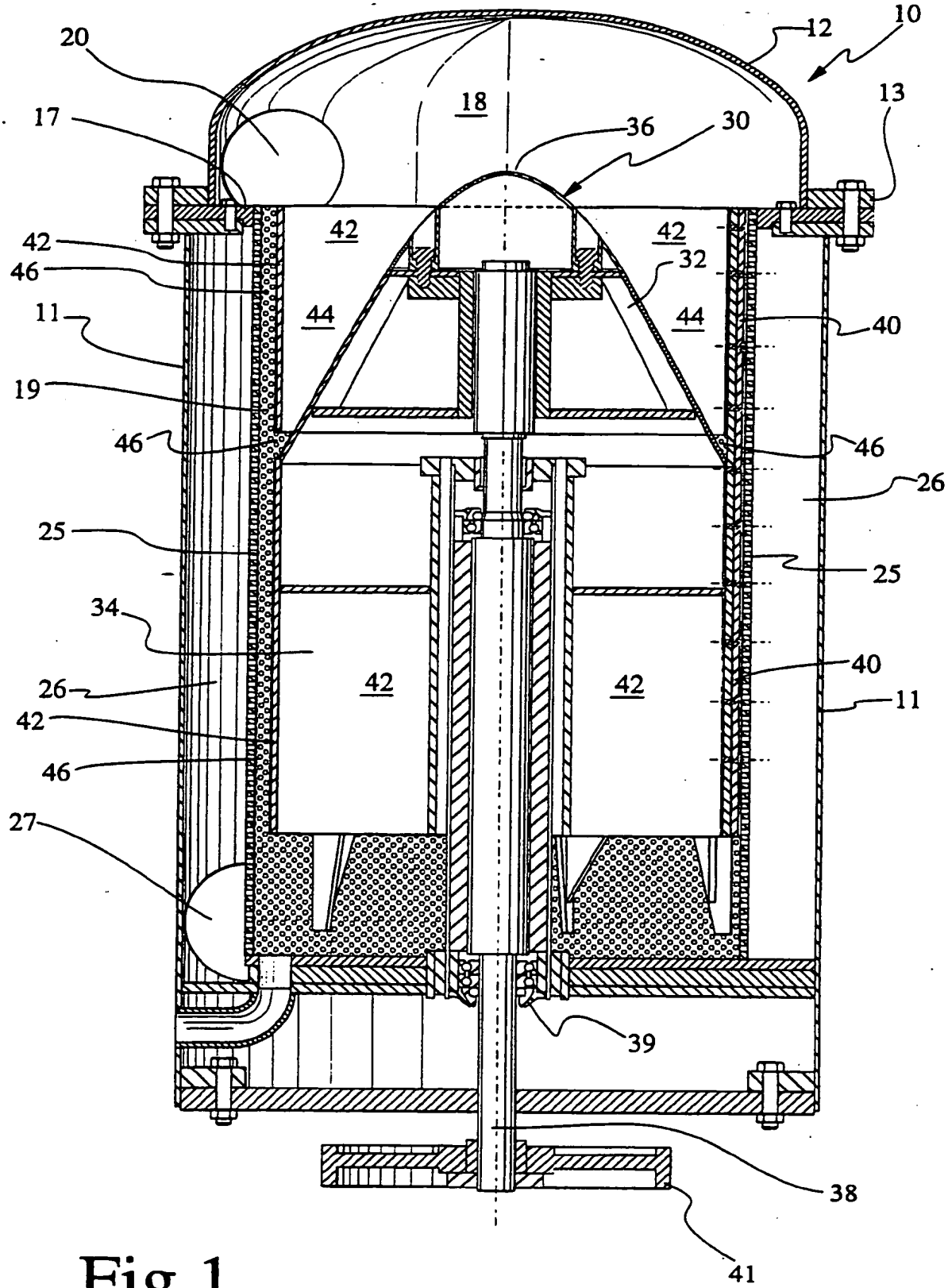
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Fig.1

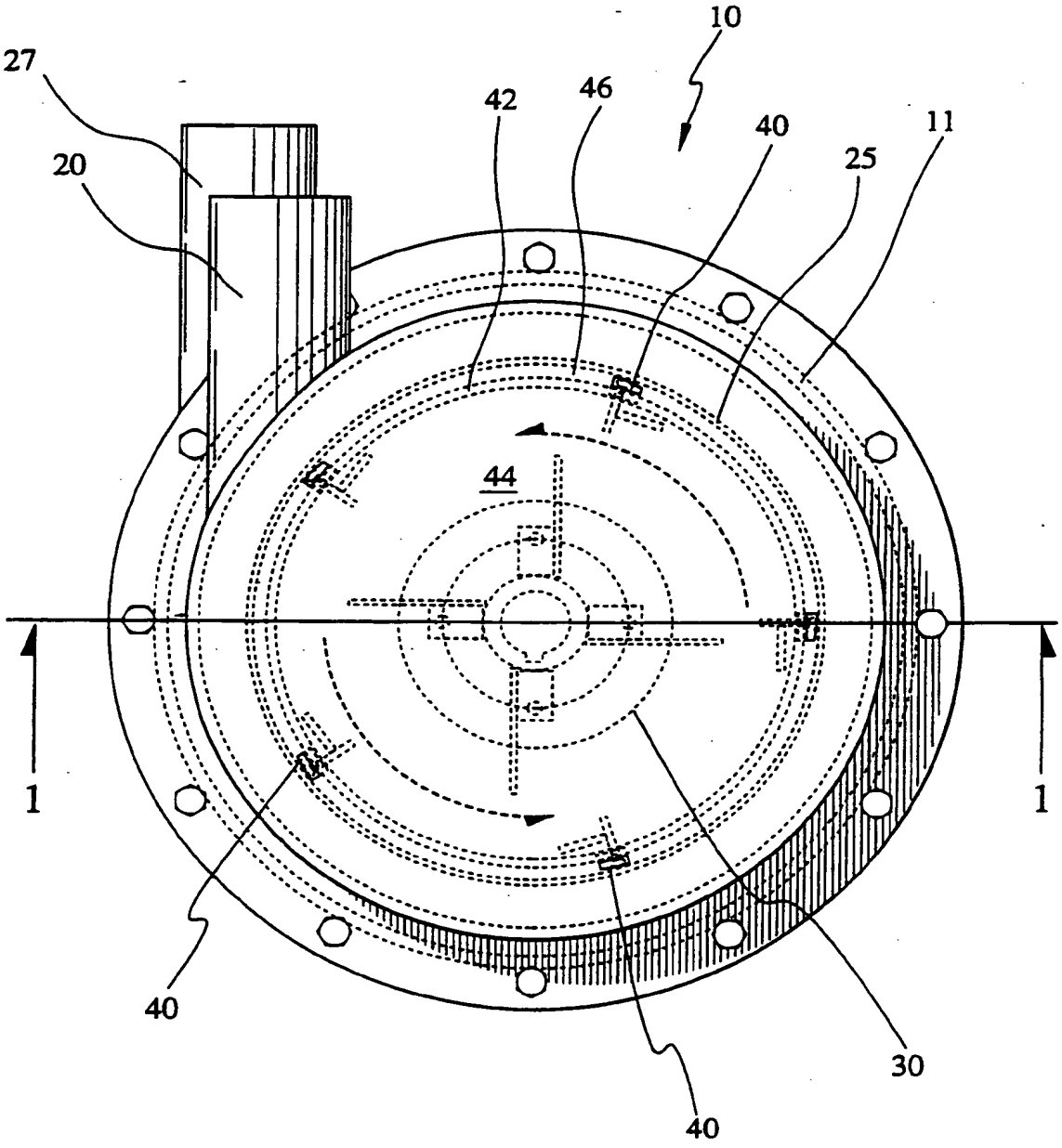
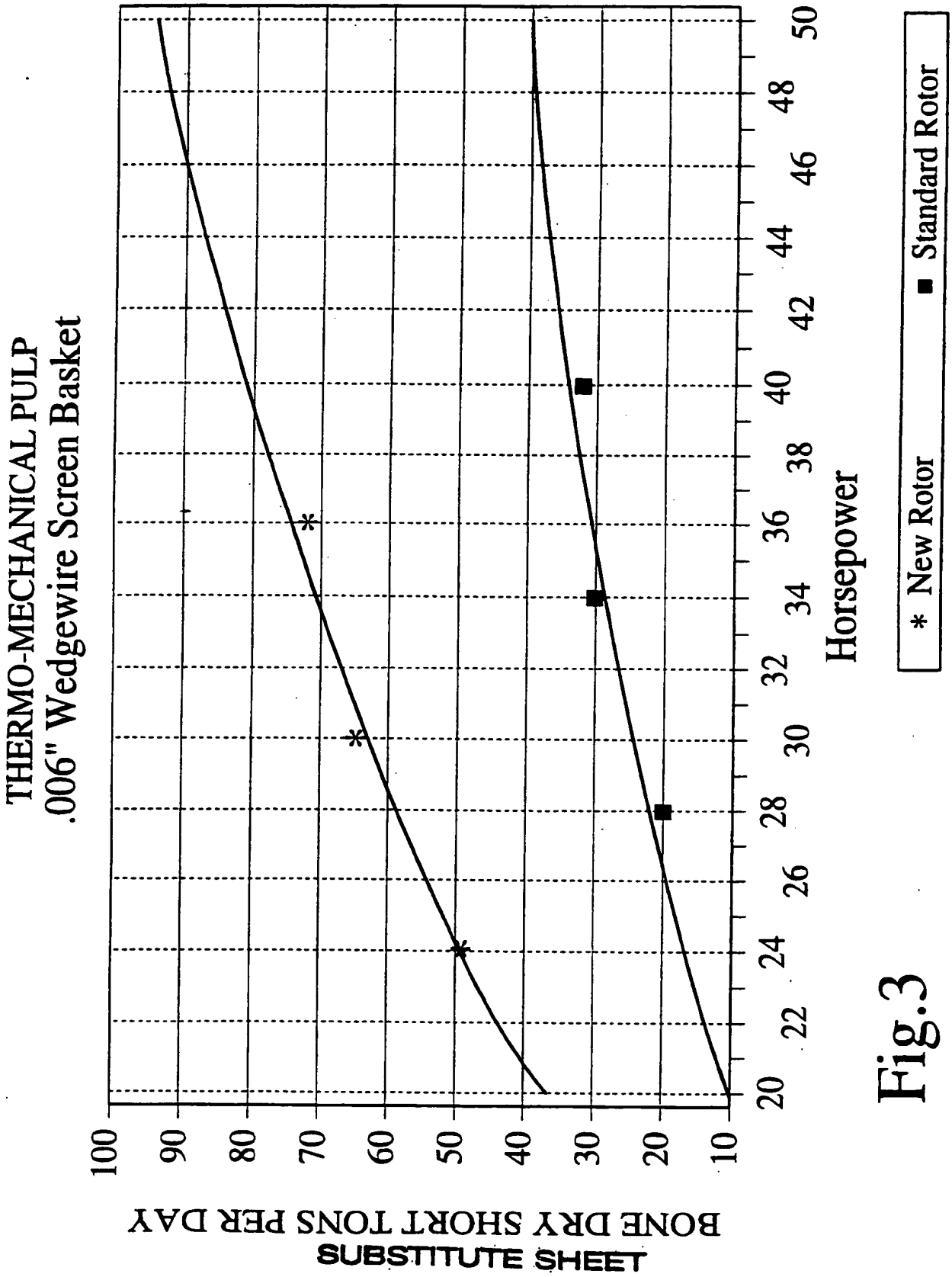


Fig.2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.006" Wedgewire Screen Basket
BONE DRY SHORT TONS PER DAY
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* New Rotor
■ Standard Rotor

Fig.3

INTERNATIONAL SEARCH REPORT

Intern. al Application No
PCT/CA 94/00579

A. CLASSIFICATION OF SUBJECT MATTER
IPC 6 D21D5/02

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 6 D21D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US,A,4 642 189 (HOOPER) 10 February 1987 cited in the application see the whole document	1,3,5
A	US,A,4 744 894 (GAULD) 17 May 1988	

☐ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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6 December 1994	03. 01. 95

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INTERNATIONAL SEARCH REPORT

information on patent family members

Intern. al Application No
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A-4642189	10-02-87	CA-A- 1238604 EP-A,B 0145365	28-06-88 19-06-85
US-A-4744894	17-05-88	NONE	